

QUANTUM PHYSICS

WITH DR DANIEL TERNO

Talking *points*

KNOWLEDGE

1. What is an ultra-compact object (UCO)?
2. What is an event horizon?

COMPREHENSION

3. What does the theory of general relativity describe, and why is it important for understanding black holes?
4. Why are event horizons and singularities unobservable?

APPLICATION

5. What questions would you ask Daniel about any uncertainties you have about the terms described in this article?
6. Why do you think that an understanding of quantum theory is helping advance technology and computing?

ANALYSIS

7. Why are mathematical black holes (MBH) and physical black holes (PBH) not necessarily the same? Why is this a challenge for understanding the Universe?
8. Why do you think that Daniel's team's discovery that 'exotic' material is needed to form black holes is so significant? What do you think are the next steps to linking their findings to wider mathematical and physical understandings?

EVALUATION

9. The study of far-off, distant objects is sometimes hard to link to societal goals. What benefits do you think the study of black holes brings to society?
10. Daniel mentions that in the future, artificial intelligence (AI) may be tasked with solving the questions currently being assessed by theorists such as himself. To what extent do you think this poses a threat or an opportunity to quantum physicists and people in related fields?

Activity

One of the most challenging aspects of quantum physics and theoretical physics is that, due to the complexity of the concepts they rely on, their findings are difficult to communicate to non-physicists. Choose one of the following titles:

- **Black holes:** what we know and what we don't
- **General relativity:** why it's important and how it's used
- **Quantum physics:** going smaller than atoms

Design a poster based on your chosen title, using the information in the article and from sources you find online. The poster should be aimed at people 2-3 years younger than yourself. While designing the poster, consider the following:

- What are my key messages I want to get across? Why is this concept interesting or important?
- What is the appropriate level of detail for my audience?
- How can I use visual design to make my poster more engaging?
- What are some inventive ways I can use to describe this concept – for instance, fun similes or metaphors?
- Could references to popular culture – such as sci-fi – be useful (or possibly counterproductive)?

Show your poster to people in younger years, or alternatively invite your classmates to put themselves in the shoes of people a few years younger and read the poster. Do they find it interesting? Do they understand the concepts? What would you do differently based on the feedback you receive?

More resources

- This article from Space.com provides a detailed but accessible introduction to black holes, including the different types and how we observe them:
www.space.com/15421-black-holes-facts-formation-discovery-sdcmp.html
- Pravin recommends the videos of lecturer Walter Lewin as an inspiring introduction to many ideas of physics:
www.youtube.com/channel/UCiEHVhv0SBMpP75JbzJShqw
- This article from Caltech provides an introduction to quantum physics, including the history of the field and the core concepts involved:
scienceexchange.caltech.edu/topics/quantum-science-explained/quantum-physics